CLAIMS

That which is claimed is:

1. A bi-directional steerable guidewire having a deflectable tip which comprises:

an elongated flexible tubing having proximal and distal portions;

a flexible helical coil having multiple turns and having proximal and distal ends, said helical coil being formed from an elongated member having a rectangular cross-sectional configuration and having continuous undulations wherein the undulations of adjacent turns interlock with each other in order to enhance the rotational rigidity of the coil, the proximal end of said helical coil is attached to the distal portion of the flexible tubing;

an elongated deflection member having proximal and distal portions and being slidably disposed within said tubing and within said helical coil, the distal portion of said deflection member being flattened to form a deflection ribbon which extends in a plane;

a retaining ribbon having proximal and distal ends, the proximal end of the retaining ribbon is attached to the distal portion of the flexible tubing and the retaining ribbon is oriented to extend in a plane which is generally parallel to the plane of the deflection ribbon; and,

an attachment member engaging the distal end of the helical coil, the distal portion of the deflection member and the distal end of the retaining ribbon so that longitudinal movement of the deflection member in a distal direction causes the distal end of the helical coil to be deflected in one direction and longitudinal movement of the deflection member in a proximal direction causes the distal end of the helical coil to deflect in another opposite direction.

2. A bi-directional steerable guidewire as defined in Claim 1, wherein the continuous undulations take the form of a sinusoidal wave having positive and negative peaks and in which the positive peaks of adjacent turns of coils engage negative peaks of adjacent turns.

3. A bi-directional steerable guidewire as defined in Claim 1, wherein the continuous undulations take the form of a square sinusoidal wave having positive and negative peaks and in which the positive peaks of adjacent turns of coils engage negative peaks of adjacent turns.

4. A bi-directional steerable guidewire as defined in Claim 1, wherein the elongated member has a square cross-sectional configuration.

5. A bi-directional steerable guidewire as defined in Claim 1, wherein the retaining ribbon and the deflection ribbon are normally biased in an arcuate configuration to thereby cause the distal end of the helical coil to be normally biased in a curved shape.

6. A bi-directional steerable guidewire as defined in Claim 1, wherein the proximal portion of said deflection member is of a circular cross section which extends from the proximal portion of the flexible tubing to approximately the distal portion of the tubing.

7. A bi-directional steerable guidewire as defined in Claim 6, wherein the proximal end of said retaining ribbon extends from the distal portion of the flexible tubing to approximately the distal end of the flexible helical coil.

8. A bi-directional steerable guidewire as defined in Claim 1, wherein the attachment member takes the form of a rounded bead.

9. A bi-directional steerable guidewire as defined in Claim 8, wherein the rounded bead is formed with an epoxy material.

10. A bi-directional steerable guidewire as defined in Claim 1, wherein the attachment member takes the form of a rounded bead which contacts the distal end of the helical coil to define a circular surface at the distal end of the coil and the deflection ribbon engages the rounded bead at a location offset from the center of the circular surface of the rounded bead.

11. A bi-directional steerable guidewire as defined in Claim 10, wherein the distal end of the retaining ribbon engages the rounded bead at a location offset from the center of the circular surface of the rounded bead.

12. A bi-directional steerable guidewire as defined in Claim 11, wherein the distal end of the retaining ribbon engages the rounded bead at a location offset from the center of the circular surface in an opposite direction from the offset location of the deflection ribbon.

13. A bi-directional steerable guidewire as defined in Claim 12, wherein the deflection member and the retaining ribbon are joined to each other within the rounded bead.

14. A bi-directional steerable guidewire as defined in Claim 13, wherein the deflection ribbon and the retaining ribbon are formed as a single unitary element.

15. A bi-directional steerable guidewire as defined in Claim 14, wherein the deflection ribbon and the retaining ribbon are joined to form a generally U-shaped configuration to thereby provide a predetermined spacing between the deflection ribbon and the retaining ribbon and to maintain the deflection ribbon and the retaining ribbon in planes which are parallel to each other.

16. A bi-directional steerable guidewire as defined in Claim 15, wherein the deflection ribbon is formed by flattening an intermediate portion of the deflection member and the retaining ribbon is formed by flattening a distal portion of the deflection member.

17. A bi-directional steerable guidewire as defined in Claim 16, wherein the retaining ribbon is of a thickness which is less than the thickness of the deflection ribbon.

18. A bi-directional steerable guidewire as defined in Claim 17, wherein the deflection ribbon is of a thickness equal to about .002 inches and the retaining ribbon is of a thickness equal to about .0015 inches.

19. A steerable guidewire having a deflectable tip which comprises:

an elongated flexible member having proximal and distal portions;

a flexible helical coil having multiple turns and having proximal and distal ends, said helical coil being formed from an elongated member having a rectangular cross-sectional configuration and having continuous undulations wherein the undulations of adjacent turns interlock with each other in order to enhance the rotational rigidity of the coil, the proximal end of said helical coil is attached to the distal portion of the elongated flexible member; and,

a rounded bead engaging the distal end of the helical coil.

20. A steerable guidewire as defined in Claim 19, wherein the continuous undulations take the form of a sinusoidal wave having positive and negative peaks and in which the positive peaks of adjacent turns of coils engage negative peaks of adjacent turns.

21. A steerable guidewire as defined in Claim 19, wherein the continuous undulations take the form of a square sinusoidal wave having positive and negative peaks and in which the positive peaks of adjacent turns of coils engage negative peaks of adjacent turns.

22. A steerable guidewire as defined in Claim 19, wherein the elongated member has a square cross-sectional configuration.

23. A steerable guidewire having a deflectable tip which comprises:

an elongated flexible tubing having proximal and distal portions;

a flexible helical coil having multiple turns and having proximal and distal ends, said helical coil being formed from an elongated member having a rectangular cross-sectional configuration and having continuous undulations wherein the undulations of adjacent turns interlock with each other in order to enhance the rotational rigidity of the coil, the proximal end of said helical coil is attached to the distal portion of the flexible tubing;

an elongated deflection member comprised of proximal and distal portions and being slidably disposed within said tubing and within said helical coil, the proximal portion of the deflection member being of a cylindrical cross section and the distal portion of said deflection member takes the form a deflection ribbon which extends in a plane;

a retaining ribbon having proximal and distal ends, the proximal end of the retaining ribbon is attached to the distal portion of the flexible tubing and the retaining ribbon is oriented to extend in a plane which is generally parallel to the plane of the deflection ribbon; and,

an attachment member engaging the distal end of the helical coil, the distal portion of the deflection member and the distal end of the retaining ribbon so that longitudinal movement of the deflection member in a distal direction causes the distal end of the helical coil to be deflected in one direction and longitudinal movement of the deflection member in a proximal direction causes the distal end of the helical coil to deflect in another opposite direction.

24. A steerable guidewire as defined in Claim 23, wherein the continuous undulations take the form of a sinusoidal wave having positive and negative peaks and in which the positive peaks of adjacent turns of coils engage negative peaks of adjacent turns.

25. A steerable guidewire as defined in Claim 23, wherein the continuous undulations take the form of a square sinusoidal wave having positive and negative peaks and in which the positive peaks of adjacent turns of coils engage negative peaks of adjacent turns.

26. A steerable guidewire as defined in Claim 23, wherein the elongated member has a square cross-sectional configuration.

27. A steerable guidewire as defined in Claim 23, wherein the retaining ribbon and the deflection ribbon are normally biased in an arcuate configuration to thereby cause the distal end of the helical coil to be normally biased in a curved shape.

28. A steerable guidewire as defined in Claim 23, wherein the distal portion of the deflection member and the deflection ribbon are formed from a wire of a circular cross section and in which the distal portion is flattened to form the deflection ribbon.

29. A steerable guidewire as defined in Claim 28, wherein the attachment member takes the form of a rounded bead which contacts the distal end of the

helical coil to define a circular surface at the distal end of the coil and the deflection ribbon engages the rounded bead at a location offset from the center of the circular surface of the rounded bead.

30. A steerable guidewire as defined in Claim 29, wherein the distal end of the retaining ribbon engages the rounded bead at a location offset from the center of the circular surface of the rounded bead.

31. A steerable guidewire as defined in Claim 30, wherein the distal end of the retaining ribbon engages the rounded bead at a location offset from the center of the circular surface in an opposite direction from the offset location of the deflection ribbon.

32. A steerable guidewire as defined in Claim 31, wherein the deflection member and the retaining ribbon are joined to each other within the rounded bead.

33. A steerable guidewire as defined in Claim 32, wherein the deflection ribbon and the retaining ribbon are joined to form a generally U-shaped configuration to thereby provide a predetermined spacing between the deflection ribbon and the retaining ribbon and to maintain the deflection ribbon and the retaining ribbon in planes which are parallel to each other.

34. A steerable guidewire as defined in Claim 33, wherein the deflection ribbon is formed by flattening an intermediate portion of the deflection member and the retaining ribbon is formed by flattening a distal portion of the deflection member.

35. A steerable guidewire as defined in Claim 34, wherein the retaining ribbon is of a thickness which is less than the thickness of the deflection ribbon.

36. A steerable guidewire as defined in Claim 26, wherein the proximal portion of the elongated flexible tubing is coupled to a control handle and the elongated deflection member is mounted with the control handle for longitudinal movement.

37. A steerable guidewire as defined in Claim 36, wherein said control handle includes a movable knob which is coupled to the elongated deflection member for longitudinal positioning of the deflection member.

38. A steerable guidewire as defined in Claim 37, wherein said control handle is coupled to the elongated flexible tubing with a release mechanism so that the handle may be removed from the guidewire.

39. A steerable guidewire as defined in Claim 38, wherein the elongated deflection member extends through the entire length of the control handle and beyond the proximal end of the control handle.